NEAFWA ABSTRACT ARCHIVES: 2015 Conservation Engineering Sessions

Conservation Engineering	
Monday, April 20, 2015 1:00 p.m. - 4:20 p.m.	
1:00 p.m.	**Applications of Stream Simulation Design Procedures by Fish Passage Engineering for Road Crossings and Removal of Dams in the Northeast** *Jesus Morales, E.I.T., Regional Fish Passage Engineer, U. S. Fish and Wildlife Service, Northeast Regional Office, Fisheries Program* The Fisheries Program in the U. S. Fish and Wildlife Service (Service) has diversified our capabilities in Fish Passage Engineering to address critical needs in aquatic connectivity, sustainability, and resilience at road crossings and remnant dams. From a past when higher priority was given to energy projects, Fisheries has shifted focus to reduce habitat fragmentation from dams and culverts. The impetus has come from having inventoried as many as 3000 barriers in the 420 square mile Ashuelot River sub-drainage of the Connecticut River in New Hampshire, and more recently, 59 dams are identified as abandoned in the Lower Hudson River basin. Studies have shown that there is an economic benefit of $500,000 to the American public per mile of river opened. The multiple natural resource benefits for connecting aquatic species, for naturalizing river geomorphic processes, and for improving water quality have long been known. Using the underlying benefit to human health and safety, increased funding has had bi-partisan approval. Fish Passage Engineering has added and trained hydraulic engineers, responded to some of the large number of culverts, bridge, and dam failures from Superstorms Irene and Sandy, and labored through some pilot projects in Massachusetts and New Jersey. Continuing with partners and internal Refuges projects, the Service is working on a scientific approach to establish design criteria for combined terrestrial and aquatic species passage initially on Service lands. Applications and results from the pilot projects and the rebuilds after Irene will be presented. Future remnant dam removals and culvert rehabilitation projects identified by the Eastern Brook Trout Joint Venture will be highlighted. Finally, areas for future partnerships with federal, state, and local transportation, emergency management, and resource agencies and ways to increase understanding and use of stream simulation guidelines will be explored.
1:20 p.m.	**Evaluating collaborative landscape conservation for headwater stream ecosystems in two northeastern U.S. watersheds** *Rachel A. Katz, University of Massachusetts-Amherst, Massachusetts Cooperative Fish and Wildlife Research Unit; Evan H. Campbell Grant, U.S. Geological Survey, Patuxent Wildlife Research Center, Northeast Amphibian Research and Monitoring Initiative; Allison H. Roy, U.S. Geological Survey, Massachusetts Cooperative Fish and Wildlife Research Unit; Dan Hocking, U.S. Geological Survey, Leetown Science Center, S.O. Conte Anadromous Fish Research Center; Benjamin H. Letcher, U.S. Geological Survey, Leetown Science Center, S.O. Conte Anadromous Fish Research Center; Michael C. Runge, U.S. Geological Survey, Patuxent Wildlife Research Center* There is growing evidence that headwater stream ecosystems are especially vulnerable to changes in climate and land use, but their conservation is challenged by the need for conservation organizations to manage both short- and long-term threats that occur at local and landscape scales. We used a structured decision making (SDM) approach to explore the benefits of landscape collaborative management strategies for headwater stream ecosystems in two northeastern US watersheds (Deerfield and Merrimack). We held 3-day workshops for each

	watershed with managers from federal, state, local and non-profit natural resource organizations to identify a diverse set of management objectives for headwater streams, including maximizing local and watershed-scale species occupancy (e.g. stream salamanders and brook trout), maintaining ecosystem services and allowing for public use. These management goals were spatially explicit, which contributed to the generation of new collaborative management actions that considered current constraints of management authority and jurisdiction. Predictive models will be built for each alternative collaborative management action and decision alternatives will accommodate uncertainty in environmental drivers and management effectiveness. Results will provide the framework to build an interactive web-based decision analysis system (the 'SHEDS' interactive web application) that is 1) relevant to management organizations, 2) emblematic of landscape-scale cooperative decisions, and 3) sensitive to the uncertainties of climate change, system states and management values.
1:40 p.m.	**NOAA Habitat Blueprint: Building and Demolition in Maine's Penobscot River Watershed** *Matthew Bernier, PE, Civil Engineer, Fisheries Habitat Restoration Specialist, ERT Contractor, NOAA Restoration Center* With a drainage area of 8,570 square miles the Penobscot River basin is the second largest watershed in New England and the largest freshwater input to the Gulf of Maine. Historically, fisheries on the Penobscot River were bountiful, with an estimated 14 to 20 million alewives (Alosa pseudoharengus), 75,000 to 100,000 Atlantic salmon (Salmo salar), and 3 to 5 million American shad (Alosa sapidissima). While still home to eleven diadromous species, including three listed under the Endangered Species Act, fish populations dwindled in the river due to dams and culverts that blocked access to historic habitat, diminished water quality, and overfishing. In 2014, as part of the National Oceanic and Atmospheric Administration's Habitat Blueprint initiative, the Penobscot River was selected as one of two Habitat Focus Areas in the Greater Atlantic Region. The Habitat Blueprint represents an opportunity for large scale restoration, building off the successful removal of the two lowermost dams on the Penobscot River. However, with over 30 hydroelectric dams, 100 non-hydroelectric dams and 2,000 culverts in the watershed, pathways to restoration are not self-evident. Working with many partners, NOAA has to break down holistic goals for watershed restoration into manageable pieces and multi-year plans. Tools for restoration include habitat protection, dam removals, fishways and culvert replacements. In contrast to a history of opportunistic restoration, the Penobscot Habitat Focus Area (HFA) will attempt to prioritize barrier removals and develop strategies for three broad habitat types: lower river (including tidal) habitat, alewife lakes and headwater streams.
2:00 p.m.	**Response of water temperature patterns following low-head dam removal in Plymouth, Massachusetts** *Matthew Conlon- University of Massachusetts Boston; Dr. Ellen Douglas- Associate Professor of Hydrology, University of Massachusetts Boston* Dam removals are becoming more common across the United States as a way of mitigating several environmental and human hazard problems. By impeding the natural flow of streams, dams can change parameters of water quality such as water temperature and dissolved oxygen (McCully 2001). Our study focused on Town Brook in Plymouth, Massachusetts. The Off Billington St. dam was one of 51 removed in 2013, and a second removal is planned for January of 2015 (American Rivers, 2014). Originally dammed for mill power generation, Town Brook saw a drastic decrease of Atlantic Herring (Culpea harengus) and Alewife (Alosa psuedoharengus). Plymouth is committed to removing these structures to encourage growth of these populations as well as general habitat restoration. Temperature was monitored at a 15-minute interval between 2012 and 2014 to evaluate the impacts of dam removal on water. Drawdown of the impoundment occurred in June of 2013, with dam removal occurring in

November of 2013. It was found that water temperature maximum/minimum moved approximately 55 minutes earlier in the day following impoundment drawdown ($P<0.00005$). One-way ANOVA revealed significant differences in temperature patterns before and after the first dam removal in 2013. Effects were more pronounced closer to dam removal site (maximum temperature P=0.02, minimum temperature P=2.31*10-7), with effect diminishing downstream due to distance and presence of other river obstructions. Moving forward, continued monitoring of water temperature along with annual fish passage counts will be used to determine the general effectiveness of dam removal along the stream. American Rivers. "51 Dams removed to restore rivers in 2013." American Rivers. American Rivers, 2014. Web. 5 Jan 2015. . McCully, Patrick. Silenced Rivers: the ecology and politics of large dams. 2nd ed. London: Zed Books Ltd., 2001. Print.

2:20 p.m.

Evaluation of Fish Passage Efficiency within the White Rock Dam Bypass Channel on the Pawcatuck River (Westerly, RI; Pawcatuck, CT)

Bryan Sojkowski, P.E., Regional Fish Passage Engineer; Jesus Morales, Regional Fish Passage Engineer

As part of an inter-agency collaboration, the United States Fish & Wildlife Service (USFWS) Fish Passage Engineering (FPE) team assisted the United States Army Corps of Engineers (USACE), and the State of Rhode Island Department of Environmental Management (RIDEM) on the development of the Pawcatuck River Fish Passage Evaluation. As part of the evaluation, the USFWS FPE team examined diadromous fish passage efficiency (specifically for the associated target species: American shad, alewife, and blueback herring) at the White Rock Dam, the first impediment to upstream migrating fish on the Pawcatuck River. The White Rock Dam splits the Pawcatuck River into a remnant millrace (power canal) that now serves as a bypass channel, and into what was formally the natural channel. The purpose of the USFWS FPE team's analysis was to determine if the bypass channel was a viable route for upstream fish passage during the migratory period of the target species. Fish passage efficiency was evaluated via a hydrologic and hydraulic investigation utilizing a variety of tools such as US Geological Survey (USGS) stream gauges, employment of localized data loggers by the USACE, total station survey of the site by the USFWS FPE team, Hydrologic Engineering Centers River Analysis System (HEC-RAS), fish counts collected by RIDEM, FishXing, and spreadsheet analyses. The results of the study demonstrated that the current conditions at the White Rock Dam inhibit the restoration of the target species on the Pawcatuck River. This conclusion was based on the fact that calculated velocities within the bypass channel exceeded the swimming capabilities of the target species for a significant amount of the upstream fish passage migratory period. The findings support removal of the White Rock Dam in order to provide the highest level of safety, resiliency, and passage efficiency for the community and targeted fish species.

BREAK 2:40 p.m.

3:00 p.m.

Hydrologic Modeling to Assess Wetland Impacts and Fish Passage Design with Dam Removal on the Lower Pawcatuck River, RI

James Turek, NOAA Restoration Center, Narragansett, RI; Thomas Decker, SUNY, Syracuse, NY; Marilyn Mroz, U.S. Army Corps of Engineers, Concord, MA

We used HEC-RAS modeling to assess changes in wetland plant community structure and diadromous fish passage with projected removal of the Potter Hill dam in the 307-mi2 Pawcatuck River watershed in southwestern Rhode Island. The Potter Hill dam has affected diadromous fish passage and other riverine functions for more than two centuries, and is a priority barrier site for achieving passage restoration throughout the mainstem. An existing USGS model was refined using LiDAR topography, sonar to refine river bathymetry, supplemental surveyed river cross sections, and use of GPR to identify bedrock controls at the dam site. With full dam removal,

	water surface elevations (WSEs) of the impounded reach are expected to drop up to 7 ft over a 0.5 mi with lesser WSE reductions extending upriver for 5.4 mi, influenced by three discrete grade controls identified within the impoundment limits. Sensitivity analysis taking into account channel bed adjustment of the restored river reach reveals that WSE drop would be decreased in elevation but increased over the reach length. We will present a summary of anticipated changes in hydrologic regimes and corresponding successional conversion of wetland cover types, and wetland to upland habitats. The analysis will include a discussion of diadromous fish passage with full dam removal and dam removal with conceptual nature-like fishway design.
3:20 p.m.	**River Herring Fishway Design Criteria Improvements in the Northeast Region** *Curtis Orvis, U.S. Fish and Wildlife Service, Fish Passage Engineering* Fishways to pass diadromous alewife (Alosa pseudoharengus) and blueback herring (Alosa aestivalis) upstream into freshwater spawning habitat were built with limited engineering along the Northeast coast reportedly as early as pre-Colonial times. From most accounts it appears that the earliest fish ladders in New England were developed and constructed as a series of pools under a common misunderstanding that river herring could jump from pool to pool in the same manner as Atlantic salmon did in fish ladders in Europe. Passage success increased when such design features as drop per pool and weir submergence were incorporated to avoid leaping behavior and keep fish in the flow. USFWS R5 Fish Passage Engineering is presently reviewing basic design elements and criteria for pool and weir, Denil, nature-like, and fish lifts and locks used by river herring in measures to make fishways more safe, effective, and efficient. A science-based approach is being used that includes review and upgrades to existing fishways, applied research, and adaptive management in fishway development. This presentation reviews selective sites in Rhode Island and the Northeast specific to river herring passage where issues and concerns include relocating entrances versus netting or building barrier dams, limiting turn pool number and reshaping walls to turn flow, reducing drop per pool and increasing submergence, re-constructing weirs for streamlined flow, matching hydraulics for hybrid pool and weir and Denil systems, and adding removable baffles to accommodate greater than 2 feet of headpond fluctuations in Denil fishways. The importance of developing accurately calibrated headwater and tailwater curves for final design will be reiterated through examples. Finally, methods for estimating fishway capacity based on literature and existing site data will be provided.
3:40 p.m.	**Energy Dissipation and Fishway Design** *Brett Towler, Ph.D., P.E., Hydraulic Engineer, Northeast Region, US Fish and Wildlife Service; Kevin Mulligan, Ph.D. Candidate, Department of Civil and Environmental Engineering, University of Massachusetts Amherst; Alex Haro, Ph.D., Research Ecologist, S. O. Conte Anadromous Fish Research Laboratory, U. S. Geological Survey* Reducing turbulence and associated air entrainment is generally considered advantageous in the engineering design of fish passage facilities. The well-known energy dissipation factor, or EDF, correlates with observations of these phenomena. However, inconsistencies in EDF forms exist and the bases for volumetric energy dissipation rate criteria are often misunderstood. A survey of existing EDF criteria will be presented; clarifications in the application of the EDF and resolutions to these inconsistencies will be provided; and specific errors in published design manuals are identified and resolved. New, design equations for culvert outlet pools and Standard Denil fishway resting pools will be presented. The presentation will underscore the utility of EDF equations, demonstrate the transferability of volumetric energy dissipation rates, and provide a foundation for future refinement of component-, species-, and life-stage-specific EDF criteria.
4:00 p.m.	**An Analysis of Partial-Depth, Floating, Impermeable Guidance Structures for Downstream Fish Passage at Hydroelectric Facilities** *Kevin Mulligan, University of Massachusetts Amherst*

	Impermeable guidance structures (or guide walls) are used to improve passage efficiency of out-migrating anadromous fish species. Their purpose is to guide the fish to a bypass (i.e. a sluice gate, weir, or pipe) allowing the fish to circumvent the turbine intakes and safely pass downstream. This presentation evaluates the flow field immediately upstream of a guide wall using a computational fluid dynamics (CFD) model of an idealized power canal. The design parameters investigated were the angle and depth of the guide wall and the average approach velocity in the power canal. Key findings indicate that a guide wall set at a small angle (15° is the minimum in this study) and deep enough such that sweeping flow dominant conditions exist within the expected vertical distribution of the approaching fish will create optimal hydraulic conditions that typically correlate to effective passage.